The Nuclear Regulatory Commission Generic Environmental Impact Statement for In-situ Uranium Recovery: Discussion of the Need and Process, Emphasizing Stakeholder Interactions

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The Nuclear Regulatory Commission (NRC) has undertaken the development of a Generic Environmental Impact Statement (GEIS) as a programmatic assessment of the potential environmental impacts associated with uranium recovery at milling facilities employing the in-situ leach (ISL) or in-situ recovery (ISR) process, principally in the Western United States. The GEIS will be conducted in accordance with the National Environmental Policy Act of 1969 (NEPA) and NRC's implementing regulations contained in 10 Code of Federal Regulations (CFR) Part 51. Site-specific Environmental Assessments (EA) will be tiered from the GEIS to the maximum extent practical with site-specific Environmental Impact Statements (EIS) prepared in cases where the range of environmental impacts of the evaluated alternatives at a specific site may not be within the bounds of those considered in the GEIS.

The decision to undertake the development of the GEIS was driven by the increasing interest in uranium recovery within the United States as part of the larger nuclear renaissance taking place here and abroad. The nuclear renaissance is driven in large part by concerns about global warming given that nuclear power produces a minimal carbon footprint and is an extremely efficient means to provide a reliable baseload source of electricity. This renaissance is also driven by the markedly increasing need for reliable energy within both developed countries and the growing economies in countries such as China and India. Currently, there are more than 300 new nuclear power plants planned or under construction around the world (6). The demand for uranium is expected to grow considerably over the next several years given that multiple countries around the world are currently operating nuclear reactors and are seeking to expand that capacity while

many other countries are seeking to develop new nuclear power generating capacity.

Nuclear power currently produces 16 percent of the world's electricity and approximately 20 percent of the electricity generated in the United States (4). The percentage of electricity supplied by nuclear power has remained steady over several decades, due in large part to power uprates and through increased efficiency in operations, rather than new power plants coming on line. The US currently has 104 nuclear power reactors and the prevailing mindset amongst utility companies is that such capacityshould be expanded considerably. The NRC Public Web Page indicates that the NRC currently has 17 Construction and Operating License (COL) applications for 26 new reactors to review and may receive as many as 21 COLs for 33 new reactors over the next few years.

Nuclear power plants are fueled by uranium hexafluoride UF6, converted into UO2 powder, which is processed into ceramic pellets, placed into fuel rods which are part of a larger fuel assembly. Fuel assemblies contain up to 264 fuel rods and are approximately 12 feet long. Such fuel assemblies are used to power both Boiling Water Reactors (BWR) and Pressurized Water Reactor (PWR) in the United States and around the world. The average 1,000 Megawatt (MW) nuclear reactor uses approximately 500,000 pounds of uranium per year and requires approximately 2 million pounds for initial full core loading startup (5).

In terms of uranium supply to meet the growing demand, in 2006, all uranium producing countries produced an estimated 103 million pounds of uranium (58 percent from primry production and 42 percent from secondary production; in terms of process, 9 percent using byproduct recovery, 25 percent using in-situ recovery, and 66 percent using

conventional mining) (5). On an international basis, this level of production would result in a future shortfall of uranium supply of approximately 74 million pounds annually (4). The US produced 4 million pounds of uranium in 2006 and therefore, domestic nuclear reactors have been forced to obtain uranium from foreign producers, resulting in a significant US dependence on foreign energy sources in a tighter international market (3). The current market conditions, coupled with a rising demand for more uranium in view of the growth of nuclear power around the world, has caused a dramatic increase in the price of uranium from $7-8 per pound in 2002 to $80-$130 per pound in 2007. The US imports the majority of its uranium from Canada and Australia with a smaller amount coming from Asian countries such as Kazakastan.

The current international market, the need to counter dependence on foreign energy sources, and the high prices paid for uranium are driving a rapidly expanding industry in the United States. As a result, the NRC estimates as many as 29 applications for new, expanded or restart uranium recovery operations over a four year period which commenced in 2007. The NRC is responsible for regulating uranium milling, to include heap-leach, conventional and in-situ recovery of uranium. Specifically, under the Atomic Energy Act of 1954, as amended, (AEA), the NRC has statutory responsibility for protection of public health and safety and the environment related to source materials (defined as uranium and or thorium). One significant NRC responsibility as set forth in 10 CFR Parts 40.1 and 40.3 is to issue source material licenses to "receive title to, receive, possess, use, transfer, or deliver any source material after removal from its place of deposit in nature". The regulatory criteria to be satisfied in obtaining a license from the NRC for these purposes is contained in 10 CFR Part 40, Appendix A. The licensing

process includes both an extensive documented safety analysis and a comprehensive environmental review.

The industry prefers to utilize in-situ recovery whenever possible because is it less costly, more efficient and considerably more environmentally friendly provided the necessary conditions such as ground-water hydraulic barriers, permeability and leachability are present. The major downside of in-situ recovery is that it takes place within a ground-water aquifer which must be restored to either baseline conditions (pre-operational), Environmental Protection Agency (EPA) drinking water standards, or to an approved alternate concentration limit. However, the in-situ recovery can only take place within an exempted aquifer or that portion of the aquifer that has been exempted by the EPA. The criteria for aquifer exemption is set forth in 40 CFR 146.4, which in essence requires that the aquifer may not serve as a underground source of drinking water.

NEPA requires all Federal agencies, including the NRC, to assess the potential environmental, social and economic impacts resulting from various alternative courses of action during the planning stages of projects, plans, policies, and programs (8). The analysis helps inform Federal decision-makers of the impacts that could result from the selection of one of the various alternatives under consideration. The NRC decided to develop a GEIS or Programmatic Environmental Impact Statement (PEIS) following NEPA requirements and Council on Environmental Quality (CEQ) Implementing Regulations in 10 CFR 40 Parts 1500 to 1508 to address general impacts on human health and the environment resulting from ISR uranium recovery licensing and operations. The GEIS will serve as a programmatic document on which site-specific assessments and

related compliance documentation will be based. The GEIS will serve as a bounding document upon which site-specific EAs will be tiered and will serve as the major baseline analysis for any site specific EISs if a Finding of No Significant Impact (FONSI) cannot be reached in completing the site-specific EA.

The NRC requirements in 10 CFR Part 51.20 (b)(8) specifies that issuance of a license to possess and use source material for uranium milling or production of uranium hexafluoride pursuant to Part 40 requires the development of an EIS to support the licensing action. The decision by the NRC to conduct the GEIS was driven to a large degree by resource limitations while striving to fulfill the requirements for conducting an EIS. Putting this concern in context, the NRC staff estimated that it would take approximately 2 Full Time Equivalents (FTE) and $1.5 Million to conduct an EIS for each of the new ISR applications and minimally an EA for each expansion or restart. Thus, it became readily apparent that such resources would not be obtainable in a timely manner given overall competing agency needs for resources, especially in view of agency growth to support all of the COLs in house or expected near term.

Given this situation, the most efficient and cost effective way to fulfill all environmental review requirements was to use the PEIS allowed by CEQ regulations through development of the GEIS. The NRC staff estimated that this approach would result in saving an estimated 7 FTE and $6.2 Million over the planning and review period, assuming all ISR applications are received as indicated in Credible Letters of Intent submitted by the companies planning to pursue ISR of uranium. In addition, the decision to conduct the GEIS will reduce duplicative findings given the large number of sites expected to be licensed and will allow a better focus at each of the sites relative to

any site-specific conditions such as ground water hydrology or cultural history issues.

It is also worth noting the staff initially considered having the GEIS address both ISR facilities and conventional mills. However a decision was made to limit the GEIS to ISR facilities because the impacts associated with a conventional mill, such as mill tailings impoundment etc., would make reaching a FONSI conclusion extremely unlikely. Moreover, the expectation was that only a limited number of applications for conventional mills was expected and the economy of scale did not warrant modifying the planned GEIS to include these facilities. However, the NRC did develop a GEIS in 1980, NUREG-0706 to address conventional milling for uranium recovery and very little has changed since that time regarding this uranium recovery technique.

The NRC staff decided to utilize the services of the Center for Nuclear Waste Regulatory Analyses (CNWRA) to develop the GEIS given the ongoing contractual arrangements with the CNWRA to provide support for review of the Yucca Mountain application for a high level waste repository coupled with their expertise in the earth sciences and environmental reviews. The contract with CNWRA required that they prepare a Purpose and Need Statement; develop the proposed action and alternative; conduct site visits; develop a description of the affected environment; develop a description of environmental impacts as part of the GEIS; prepare a Scoping Summary Report and provide technical assistance to the NRC staff during a series of public meetings as part of the scoping process as well during review of the Draft GEIS.

In developing the description of environmental impacts, the CNWRA was directed to utilize previous applicable NEPA reviews as appropriate; NUREG-1569: Standard Review Plan for In-Situ Leach Uranium Extraction License Applications; NUREG-1748:

Environmental Review Guidance for Licensing Actions Associated with NMSS Programs and Regulatory Guide 3.8: Preparation of Environmental Reports for Uranium Mills. These documents served as the baseline for identifying cumulative impacts, potential impacts, postulated accident scenarios and typical historic or planned mitigation measures. All of the areas of potential environmental impacts set forth in NUREG-1748, Section 5.4 were to be evaluated including: Land use; Transportation; Geology and soils; Water resources; Ecology; Meteorology, Climatology and air quality; Noise; Historic and cultural resources; Visual/scenic resources; Socioeconomic; Environmental justice; Public and occupational health and Waste management (1).

The GEIS was structured in a manner that will provide maximum utility for future site-specific reviews and that may alleviate some of the public concerns that have been expressed regarding legacy issues from previous uranium recovery activities or as expressed during the scoping process. The GEIS does not consider specific locations or facilities, rather it provides an assessment of potential environmental impacts associated with the construction, operation, decommissioning and aquifer restoration for ISR facilities which might be built in four regions of the Western United States. The four regions were used as a framework for discussion within the GEIS and were identified based upon several considerations including: Past and existing uranium milling sites located within States where NRC has regulatory authority over uranium recovery; Potential new sites are identified based on NRC's understanding of industry interest in pursuing uranium recovery through use of the ISR technology and Locations of historical uranium deposits within portions of Wyoming, Nebraska, South Dakota and New Mexico (3).

Using these criteria, four geographic regions were identified as follows: Wyoming West Uranium Milling Region; Wyoming East Uranium Milling Region; Nebraska-South Dakota-Wyoming Uranium Milling Region and Northwestern New Mexico Uranium Milling Region (3). The foundation of the environmental assessment in the Draft GEIS is based on the historical operations of the NRC licensed ISR facilities and the affected environment in each of the four regions. The GEIS categorizes the potential environmental impacts using significance levels. According to the CEQ, the significance of impacts is determined by examining both context and intensity (40 CFR 1508.27). Context is related to the affected region, the affected interests, and the locality, while intensity refers to the severity of the impact, which is based on a number of considerations (3). In developing the GEIS, the NRC used the significance levels identified in NUREG-1748 as follows (3):

- Small Impact: The environmental effects are not detectable or are so minor that they will neither destabilize or noticeably alter any important attribute of the resource considered.
- Moderate Impact: The environmental effects are sufficient to alter noticeably, but not destabilize important attributes of the resource considered.
- Large Impact: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

The GEIS provides NRC's evaluation of the potential environmental impacts utilizing this significance model for each of the criteria set forth in Section 5.4 of NUREG-1748, as cited earlier, relative to the construction, operation, decommissioning and aquifer restoration at an ISR facility in each of the four uranium milling regions (3). As might be

expected, the impacts range from Small to Large depending upon the activity evaluated, (transportation impacts or groundwater impacts etc.) (5).

NEPA, CEQ implementing regulations and the corresponding NRC requirements in 10 CFR Part 51 are designed to provide an explanation of major Federal actions impacting the environment and to allow the public to participate in the decision making process (4). Certainly these objective were paramount when the NRC staff was planning the Scoping Process and the overall stakeholder outreach associated with the development of the GEIS. These objectives were especially important in this instance, given the legacy issues associated with uranium recovery during the 1940s and 1950s in the Western United States, and the various strongly held views by some stakeholders as to whether uranium recovery should take place again, given that some of the earlier uranium mines have not been completely remediated. Such concerns have been expressed very strongly by the Navajo Nation in a resolution which forbids uranium recovery on Navajo land until such time as adverse economic, environmental and human health effects from past uranium mining and process have been eliminated or substantially reduced to the satisfaction of the Navajo Nation Council (7).

The NRC published a Notice of Intent to prepare the GEIS in the Federal Register on July 24, 2007 (FRN/Vol. 72, No. 141). The notice indicated the purpose of the GEIS and pointed out that the NRC would continue with the scoping process until September 4, 2007. In addition, the notice indicated that the NRC planned to conduct two public meetings as part of the scoping process to be held in Casper, Wyoming and Albuquerque, New Mexico. The two facilitated public meetings were well attended and the NRC staff received a request to add another public meeting to be held near the Navajo Nation and to

extend the public comment period. As a result of these requests, the NRC decided to respond positively and in another revised notice (FRN/Vol 72, No. 169), added a facilitated public meeting to be held in Gallup, New Mexico and extended the public comment period until October 8, 2007.

The public meeting held in Gallup, New Mexico very close to the Navajo Nation, included the use of a Navajo college professor to serve as an interpretor and provide an explanation of the GEIS and the scoping process to Navajo attendees to enhance their overall understanding of the issue. On September 27, 2007, the NRC published a second Federal Notice (FRN/Vol 72, No. 187) indicating that the public comment period was extended until October 31, 2007, as the result of several requests both in writing and as expressed during the public meetings to extend the public comment period. Subsequently on November 1, 2007, the NRC published a third revised notice (FRN/Vol. 72, No. 211) extending the public comment period until November 30, 2007. This extension was granted at the request of the National Mining Association who wanted to provide a comprehensive Generic Environmental Report as part of the public comment gathering process. The NRC decided to respond favorably to this request, given that the association represents the uranium recovery industry and had realized a great deal of effort and expense to prepare the report. Furthermore, the NRC staff thought that the report would contain much historical environmental and technical information useful to the preparation of the GEIS. The notice pointed out that this was the third extension of the comment period resulting in approximately 130 days of public comment gathering which greatly exceeded the typical length of NRC scoping periods.

The GEIS Scoping Report summarizing the determinations and conclusions reached

in the scoping process was prepared by the CNWRA for the NRC in June 2008. The report indicated that 79 individuals offered comments during the three public scoping meetings and that many of the commenters chose to make comments well beyond the GEIS scope, preferring instead to comment on the more general topic of uranium mining or milling (4). The report did note that the commenters expressed an opinion, either favorable or unfavorable, on either the GEIS or uranium mining or milling. Approximately one half of the commenters expressed support for either the GEIS or for uranium mining while the other half neither supported the GEIS nor uranium mining or milling (4). Additionally, nearly 1400 individuals sent in written comments by electronic mail with approximately 90 percent of these comments being provided as identical "form letters" opposing the GEIS (4). About 2 percent of the electronic messages were modified versions of the form letter (mostly opposing) and the remaining comments were unique individual letter addressing a variety of topics. Approximately 5 percent of the electronic submittals were from locations outside the United States (4).

The Draft GEIS was then published for public comment in July 2008 as NUREG-1910, Vol. 1 and Vol. 2 (4). The notice of availability for public comment was published on July 28, 2008 (FRN/Vol. 73, No. 145). The notice announced that the Draft GEIS would be available for public comment for a period of 90 days and that the NRC staff would hold as many as eight public meetings in Wyoming, South Dakota and New Mexico as part of the public comment gathering process on the draft document. The public meetings were well attended with stakeholders providing a broad spectrum of comments on the GEIS and on the general topic of uranium mining and milling. The views of the commenters were both favorable and unfavorable to the contents of the

Draft GEIS and the technical approach utilized, i.e. the four regions, as well as to the approach of utilizing a programmatic analysis including the use of tiering versus preparation of a site-specific EIS for each ISR facility.

During the public meetings the NRC received several requests to extend the public comment period for an additional 180 days. On October 3, 2008, the NRC announced (FRN/Vol.73, No 193) an extension of the comment period for an additional 30 days which would allow additional comment gathering while working to stay on schedule to complete the Final GEIS in June 2009.

The NRC staff received 2,200 comments focusing on 40 areas of the draft document. Sixty five of the comments received were supportive of the GEIS, while approximately 35 of the unique letters expressed opposition to the GEIS (2). In addition, approximately 1,500 identical letters expressed opposition to the document. A significant number of the comments addressed cumulative effects; Native American issues; ecology; federal and state interactions; groundwater; cultural resources; legacy sites; and public interaction. Ground-water issues received the most attention primarily focusing on the risk of excursions and leaks to water supplies and the ability to restore the groundwater to baseline conditions (2). Legacy comments focused on historical excursions and resultant impacts to health and the environment as well as the legacy of conventional mining and milling (2).

Several commenters expressed the view that the GEIS should include a more comprehensive treatment of cumulative effects and specifically noted the need to consider historic mining activities and reasonably foreseeable activities that may contribute to environmental impacts (2). Native American concerns focused on

environmental justice, impacts to cultural resources and jurisdictional issues. Ecology commnents were generally related to concerns about habitat disruption due to land disturbance and hazards posed by waste streams. Comments regarding federal and state interactions primarily related to the impact on federal lands and consideration of state requirements and actions. Several commenters expressed concern that the GEIS would limit public involvement and was "fast tracking" a thorough review and many commenters requested that site specific EIS's should be conducted for each site (2). All of these comments will be considered and evaluated as the NRC staff finalizes the GEIS which is currently scheduled to be completed in June 2009.

The NRC made a concerted and successful effort to fulfill all of it's obligations to the NEPA process in developing the GEIS both in terms of intent and to the letter of the law. In addition to the various public notices and public comment gathering meetings discussed earlier, the agency communicated with the Governor of the State of New Mexico and met with public health officials of that state to explain the use of the GEIS; entered into a Memorandum of Understanding with the State of Wyoming as a Cooperating Agency for the development of the GEIS and met with the Navajo Nation to better understand their concerns and to clarify the role of the GEIS.

Throughout the overall process of developing the GEIS a number of key issues and lessons learned were revealed including the following: 1) The role of the Programmatic EIS (GEIS in the NRC approach) was misunderstood and questioned; 2) The degree of public participation markedly impacts the overall project timeline for completion; 3) Industry needed an explanation of the timing of the GEIS as compared to conducting site-specific EIS's for each facility; 4) Certain sites may require conducting a site-specific

EIS regardless of the thoroughness of the GEIS; 5) Uranium recovery generates strong views amongst the public both for and against it; 6) Contractors assisting Federal agencies in developing programmatic environmental impact statements must have expertise in the NEPA process; 7) There is an overall mistrust of the environmental review process and 8) The public and stakeholders must be involved early and effectively in the process. In the final analysis, the NRC believes that the GEIS will be thorough and effective in evaluating the environmental impacts of ISR, provides efficiency in the environmental review process, avoids redundancy, utilizes the tiering process as envisioned by CEQ regulations and was absolutely necessary in order for the NRC to fulfill it's NEPA obligations relative to ISR in view of resource constraints. Furthermore, the development of the GEIS placed a great deal of emphasis on stakeholder outreach: not only within the scoping process and public comment gathering efforts; but also through enhanced public meetings; extended comment collection and meetings with Native Americans; as well as with the states in which in-situ uranium recovery will take place. In the final analysis, while this was an expensive and labor intensive process, it was the appropriate course of action, especially in view of the legacy issues associated with uranium recovery and the potential importance of this technology in addressing our future energy needs.

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